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COMMITTEE ON THE PEACEFUL
USES OF OUTER SPACE

NATIONAL RESEARCH ON SPACE DEBRIS

SAFETY OF NUCLEAR-POWERED SATELLITES

PROBLEMS OF COLLISIONS OF NUCLEAR POWER SOURCES WITH SPACE DEBRIS

Note by the Secretariat

Addendum

The present document contains information provided in replies received from Member States up to 21 February 1994.

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*The replies are reproduced in the form in which they were received.

UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

[Original: English]

In April 1993 the British National Space Centre co-sponsored the First European Conference on Space Debris held in Darmstadt, Germany and hosted by the European Space Agency. This meeting was established as a major international forum for the discussion of technical and legislative problems associated with orbital debris.

The first UK Orbital Debris Industry/Academia Coordination Group Meeting was held in London on 2 September 1993. Representatives from UK Government, Industry and Universities met to coordinate a national initiative aimed at combatting the orbital debris problem. A round table discussion concluded that both short and long term risk analyses should be carried out to identify and characterise the dominant hazards to current and future space assets.

A number of technical papers have been produced by UK researchers during 1993:

The problem of predicting the long term growth of the satellite and debris population in Low Earth Orbit (LEO) was explored by McInnes¹. The work was extended to consider the possibility of self-sustaining cascade fragmentations and identified the dominant influence of orbital altitude, and therefore atmospheric density and drag on the rate of buildup².

UNISPACE, the Unit for Space Sciences at the University of Kent, continue to enhance their retrieved surface analysis capability and add to the growing database of impact phenomena. The Unit continues to lead the debate on the relative contribution of debris and meteoroids to the LEO particulate environment³. This analysis is enhanced by studies of crater morphology to permit deconvolution of flux characteristics and therefore population statistics⁴. This effort aimed at analysis of retrieved surface analysis from satellites such as the Long Duration Exposure Facility (LDEF)⁵, is also supported by hydrocode modelling⁶. UNISPACE studies indicate the presence of a population of debris in eccentric orbits which is not represented by the current engineering models, but which can have a profound impact on satellite and shielding design.⁷

The Defence Research Agency carried out investigations into the reentry prediction of risk objects⁸ and used the PION reentry prediction campaign, coordinated by the European Space Agency, to improve understanding of the reentry processes. The Defence Research Agency also carried out simulations of the effect of satellite breakups within LEO constellations⁹ and sought design measures to minimise both the vulnerability of both the system to such an event, and also the general population of LEO satellites. The Defence Research Agency also carried out a programme of research with the Royal Greenwich Observatory and the University of St. Andrews to consider the selection effects associated with optical sensing of objects on the geostationary ring¹⁰. It was concluded that the threshold minimise size of object that can be detected by optical systems is influenced greatly by the departure from the nominal geostationary values of the object's orbital eccentricity and inclination. Consequently debris objects, whose trajectories would be allowed to drift from the nominal geostationary values would only be detectable at larger size regime. This may explain why only a small population of debris has been detected at geostationary altitudes to date.

This optical sensing effort was complemented by the Royal Greenwich Observatory and University College, London¹¹ who sought novel optical detecting systems to improve threshold minimum detectable sizes and relieve operational constraints. Further work considering the detectability of a breakup event in Geostationary orbit is in preparation.¹² The Defence Research Agency also considered the buildup of debris in LEO, highlighting the increased hazard to polar orbiting platforms, and concluded that the collision risk will continue to grow at altitudes above 500-600 km.¹³

In association with the Defence Research Agency, the University of Southampton¹⁴ is developing theory and tools to model the short term effects of satellite breakups on operational vehicles and on the general population.

AEA Technology continue to develop their hypervelocity impact simulation capabilities. In addition to light gas gun technology, electromagnetic railgun technology has been investigated¹⁵ to simulate impacts at orbital velocities.

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